SEPTIC INFECTIONS OF THE NECK. (With special reference to Surgical Anatomy.)

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Reference to Fig. 1 will indicate that the narrow isthmus of the neck comprises four principal groups of structures which, for the purposes of this paper, are referred to as Units A, B, C, and D. Unit D is called the "Ensheathing" unit in that it effectively separates the superficial fascia from deeper structures. This anatomical division also serves to separate the two principal types of neck infection, namely those superficial to and those deep to the ensheathing unit. The former group consists of carbuncles towards the back of the neck and simple superficial infections towards the front. The latter group comprises a variety of

FIG. 1

Transverse Section of Neck to illustrate the four "Units."

deep neck lesions characterised by the fact that, whilst they arise either from lymph node suppuration or from one of the three remaining units (mostly Visceral Unit B), they spread in the fascial "spaces" which constitute the path of least resistance. Infections in this group are masked by the strong ensheathing unit and will burst through it only at a relatively late stage. The masking here referred to is a very

real handicap in the establishment of an accurate diagnosis, and operation should never be delayed in cases of doubt.

First Group.

To deal first with the superficial group, little need be said with regard to the simple superficial infections towards the front of the neck beyond a warning against maltreating them by "squeezing out" the pus or making inadequate incisions. It has to be remembered that inflammation is the body's defence against infection and that damage to it may cause spread and involvement of the lymph nodes beneath the ensheathing unit with possible consequent deep cellulitis.

Carbuncles preponderate on the back, rather than on the front of the neck, because of the relative frequency of hair follicles there. The latter lead to the subcutaneous tissue which is dense in this situation and necroses easily as tension increases. In contrast to carbuncles of the face, where subcutaneous tissues are loose, facial muscles are constantly moving and where veins are valveless and communicate with intra-cranial sinuses, danger to life is not as great and earlier operation is more justifiable. The guiding principles in the *management of a neck carbuncle* are summarized as follows:—

- (1) *Conservative.* Local and general rest essential. Keep patient in bed, shave and thoroughly cleanse part and strap with elastoplast leaving small central hole. Control any glycosuria.

Avoid unnecessary trauma, squeezing or nicking.

- (2) *Operative.* Indicated where conservative treatment fails. Crucial incision to granulation tissue barrier with limbs at 90 degrees and flaps of maximum thickness to preserve blood supply. Excise slough and pack with magnesium sulphate and glycerine which should be left in situ for about 5 days. On removal of the pack, a clean granulating wound will be left which heals without deformity.

Avoid local anæsthetics.

Second Group.

The second group consisting of deep infections presents a complicated problem and in order to understand the situation properly, it is necessary to have a clear conception of the fasciæ and so-called "fascial spaces".

This is best done by looking at the neck from the physiological standpoint and realising that there are no actual spaces in the neck at all. Developmentally, four groups of structures crystallize out of the original mesodermal mass and present as units, *each exhibiting a type of movement somewhat independent of the others*:

Unit A—Vertebral. Includes the vertebræ, cervical and brachial plexuses with all the neck muscles they innervate *except those having an additional nerve supply from a cerebral nerve.*

Unit B—Visceral. Includes air and food passages, structures developed from them and muscles concerned in their movement.

Unit C—Great Vessels. Carotid artery, jugular vein and vagus nerve.

Unit D—Ensheathing. Sterno-mastoid, trapezius and connecting fascia.

The tissue remaining between these units is at first represented by undifferentiated mesoderm, which, however, soon develops according to physiological needs. It is not unnatural to find that the parts of the vertebral unit (which exhibit a

common type of movement) are bound together with a condensation of mesoderm which we call the vertebral fascia, and transverse sections of the neck will demonstrate at once that it is wrong merely to talk of "pre-vertebral" fascia.

The visceral unit has an entirely different type of movement from the vertebral. During the act of swallowing all its components are dragged upwards by the styloid and digastric muscles which pass upwards and outwards fan-wise from the hyoid bone. After the completion of the act, the unit returns to its original position partly by gravity and partly by the action of the infra-hyoid muscles including the omo-hyoid which passes downwards and laterally in a

FIG. 2.

The visceral unit showing the stylo-pharyngeal and omo-hyoid condensations.

similar manner. Here again, a condensation of fascia occurs around these structures of like movement. Now injection experiments (Barlow 1936), demonstrate that the omo-hyoid fascia, dragged out as it were from the side of the visceral unit, tends to separate the region in front of it from that behind (Fig. 2). In the same

way, as may be shown not only by injections but also by a simple transverse section (Fig. 3), the fascia "dragged out" by the styloid muscles—particularly the stylo-pharyngeus—tends to shut off the region immediately lateral to the upper end of the pharynx from the region behind occupied by the great vessels. This condensation of fascia has been called the stylo-pharyngeal aponeurosis.

FIG. 3.

Relations of Lateral Pharyngeal Space.

Before passing on to the significance of these findings, a word is necessary about the remaining two units. The great vessel unit "C" exhibits pulsatile movement. The commonly talked-of "carotid sheath" exists as a condensation of fascia which is fairly adherent to the artery. What is not usually appreciated is that the jugular vein also has a condensation about it which is relatively loose to allow of expansion of the vein as in exertion, and that both vessel-condensations are inseparable. It is noteworthy that all the arteries passing to the visceral unit are looped to allow of the upward and downward movement of the pharynx, whilst all those passing to the vertebral unit run a straight course. The veins returning from both are provided with a loose sheath similar to the jugular sheath, and there is thus made a potential pathway for the spread of infection. In the injection experiments carried out by the writer, it was possible to show that opaque fluid injected into the sub-maxillary space would, in some instances spread along the

sheaths of the smaller veins to fill the space around the jugular vein (Fig. 4.). It is here suggested that this may throw light on the mechanism of jugular vein thrombosis i.e. that infection may enter the sheaths of small veins, track to the jugular sheath and set up a peri-venous inflammation leading to thrombosis and perhaps intra-venous suppuration.

FIG. 4.

Finally, the ensheathing unit "D", must be visualized as a kind of musculo-fascial tube extending from clavicles to mandible and skull, having intermediate attachment at the hyoid and showing a small locus of areolar tissue called the "Space of Burns" in the supra-sternal notch. Posterior to a line marked by the transverse processes, the ensheathing unit is firmly adherent to the vertebral unit and this effectively prevents spread of pus backwards beyond this line.

All the remaining originally undifferentiated mesoderm deep to the ensheathing unit and surrounding the other three units, does not develop beyond the formation of areolar tissue except for the formation of lymph nodes and vessels embedded in its substance. The position of these nodes is already generally appreciated. This loose areolar tissue constitutes the so-called "spaces" of the neck and readily provides a pathway for the spread of pus.

The areolar tissue. Of these spaces, five are sufficiently definite to warrant description and they may become separately infected:—

(1) *Retro-pharyngeal space.* This extends downwards from the base of the skull for a variable distance. Theoretically, a retro-pharyngeal abscess might enter the thorax, but in practice it rarely reaches below the level of the third cervical vertebra. Laterally, it might be supposed that the space is continuous with the sub-vaginal or "main" space of the neck (*vide infra*), but actually it is limited there by a viscerovertebral condensation of fascia which limits the spread of pus in that direction. A retro-pharyngeal abscess will rarely burst into the lateral part of the neck and it should, of course, be opened (except when tuberculous) via the pharynx with the head well down to prevent the aspiration of pus.

(2) *Sub-maxillary space.* This is bounded laterally by the mandible, below by the ensheathing fascia, medially by the mylo-hyoid and posteriorly by the digastric and stylo-hyoid muscles. It should be noted, however, that the space extends

round the posterior border of the mylo-hyoid where it is occupied by the deep part of the sub-maxillary salivary gland, and it thus comes into relation with the floor of the mouth. Further, there is a narrow potential passage directly backwards from the space between the internal pterygoid and the lateral wall of the pharynx towards the lateral pharyngeal space. Pus rarely traverses this route, but it sometimes serves as an approach (Mosher's operation) for surgical drainage of the latter space (Mosher, 1929).

Infections of the sub-maxillary space are of four kinds:—

- (a) From direct wounds.
- (b) From suppuration of lymphatic nodes embedded in the salivary gland.
- (c) From spread of infection from a tooth or from osteo-myelitis of the mandible.
- (d) From the sub-maxillary gland itself (usually non-suppurative).

When an inflammatory swelling in the sub-maxillary region is therefore presented, it is most necessary to investigate the part before resorting to operation. An X-ray is always advisable as well as an examination of the interior of the mouth, etc.

(3) *Lateral pharyngeal space*. Perhaps the most interesting of all the spaces, and one whose very existence is little known, is the lateral pharyngeal space. The boundaries of this space which is pyramidal in shape with the base upwards, are well seen in Fig. 3 and are as follows:—Laterally, the parotid salivary gland covered on its outer surface by the ensheathing fascia, anteriorly, the posterior border of the ascending ramus of the mandible with the internal pterygoid muscle, medially the lateral wall of the pharynx in which is embedded the tonsil, posteriorly, the great vessels in their sheath and separated from the space by the stylo-pharyngeal aponeurosis (*vide supra*) and superiorly by the base of the skull containing the Eustachian tube. Anteriorly, the potential passageway between the pharynx and the internal pterygoid can be seen in the section.

Owing to its protected position and to the apparent scarcity of lymphatic nodes within it, this space is not very often infected. It will however be noted that it is in very close relation to the tonsil. In the usual course of events, tonsillar infections will commonly result in lymph-node suppuration at the angle of the jaw below the level of the digastric muscle because these nodes drain the tonsil, but from time to time there may be a direct infection of the lateral pharyngeal space. The patient soon becomes very ill, but there is little to be seen on the surface, except perhaps a little oedema over the parotid suggesting a parotitis. The temperature however is high and soon the patient complains of trismus, pain in the ear due to oedema of the Eustachian tube, dysphagia and at a late stage, dyspnoea from oedema of the glottis. Owing to the trismus, examination of the mouth is very difficult. If necessary, an intravenous anæsthetic should be given, when it will be seen that the whole pharynx and soft palate are swollen and red and that the tonsil is pushed forward and inwards. This picture is easily mistaken for an ordinary quinsy, but the distinction is important because it is difficult to obtain adequate drainage of the space through the pharynx. Probably the best route for drainage is, as suggested above, through the sub-maxillary space.

(4) *Pre-tracheal space.* Areolar tissue is rather more dense here than elsewhere and there are no lymphatic nodes. The space is bounded behind by the infra-tracheal muscles, in front by the ensheathing fascia, above by the hyoid bone, and below by the attachment of the sterno-hyoid to the sternum about an inch below the top of the latter. Laterally the boundary is ill-defined but it is made by the approximation of the omo-hyoid fascial expansion to the ensheathing fascia. Owing to the absence of lymphatic nodes, suppuration in the space is uncommon. When it occurs, it is usually due either to direct wounds or to spread of infection from the visceral unit. Drainage of it is by incision of the ensheathing fascia and it should be noted that the attachment of the sterno-hyoid to the sternum below tends to prevent spread of pus to the mediastinum.

(5) *Sub-vaginal or "main" space of the neck.* Although mentioned last for convenience of description, this space is by far the most important as well as the most vulnerable of all. It represents the remainder of the areolar tissue not already described and its limitations are as follows; laterally, the ensheathing unit and medially the visceral unit. Above, it is shut off from the lateral pharyngeal space by the digastric and styloid muscles. Below, it passes down behind the omo-hyoid expansion, but is shut off from the thorax by Sibson's fascia and the apex of the pleura except medially, where there is a potential pathway to the mediastinum in relation to the visceral unit and great vessels. Lastly, it will be seen that the great vessel unit traverses this space from top to bottom and it contains the vast majority of the cervical lymph nodes.

Owing to the presence of the latter, it is extremely susceptible to pyogenic infections. The nodes may become infected from a great variety of sources, e.g. mouth, tonsils, ear, pharynx and larynx, skin of face, head and neck, etc. Moreover, the space may be involved by direct spread from the viscera or by wounds.

Suffice it to say, that any suppuration in this space, whatever its origin, tends to present as something less serious than is actually the fact because the signs of the inflammatory process are masked by the strong ensheathing unit. Indeed, a large quantity of pus may be present without the slightest reddening of the skin and certainly without any obvious fluctuation. In short, the "wooden" oedematous neck, not only indicates underlying pus, but an advanced stage of suppuration which may be dangerous, in that it may spread to the mediastinum, cause jugular vein thrombosis or considerable sloughing of the tissues, unless operation is speedily undertaken.

With regard to jugular vein thrombosis, there seems to be three ways in which it may occur:—

- (1) From inflammation surrounding the vein in a sub-vaginal space infection.
- (2) From extension of a thrombus in the lateral sinus.
- (3) By extension of pus from a distant part, e.g. the sub-maxillary space, along the sheaths of its tributaries into the sheath of the jugular vein itself. (See Fig. 4.)

In dealing with deep neck infections, the possibility of jugular vein thrombosis must always be borne in mind, since it may easily result in pyæmia. The difficulty in making a diagnosis is not great in the last two types mentioned because the tender hard vein can be felt, but in the first type where the vessel is surrounded by pus, it must be carefully examined. Where the presence of thrombosis is established, ligature below the clot may be the means of saving life.

Fortunately, spread of pus to the mediastinum from any type of fascial space infection is not common. It does however occur occasionally by tracking down in the loose areolar tissue of the retro-pharyngeal space and from the sub-vaginal space around the great vessels. More frequently, involvement of the mediastinum, is due to extension actually *within* the visceral unit, as for instance, in infected wounds of the oesophagus by a foreign body.

The foregoing description of the cervical fascia in relation to sepsis, is based on the physiological conception of the four "units" of the neck. The extent of deep inflammation is most difficult to assess and it is hoped that these notes may prove of some value in indicating the probable limitation of any particular lesion.

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